(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 598 559 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **93309019.3**

(51) Int. Cl.[5]: **D21H 23/50**, B05C 5/02

(22) Date of filing: **11.11.93**

(30) Priority: **12.11.92 US 974977**

(43) Date of publication of application:
25.05.94 Bulletin 94/21

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(71) Applicant: **Philip Morris Products Inc.**
3601 Commerce Road
Richmond Virginia 23234 (US)

(72) Inventor: **Cutright, Edwin L.**
2713 Ridgeview Road
Powhatan, Virginia 23139 (US)
Inventor: **Vogt, Howard W., Jr.**
4500 North Courthouse Road
Providence Forge, Virginia 23140 (US)
Inventor: **Scott, G. Robert**
13381 Drakewood Road
Midlothian, Virginia 23113 (US)
Inventor: **Reich, Richard B.**
1009 Jenny's Place
Midlothian, Virginia 23113 (US)

(74) Representative: **Marlow, Nicholas Simon**
Reddie & Grose
16, Theobalds Road
London WC1X 8PL (GB)

(54) Application of fluidized material to a substrate using intermittent charges of compressed air.

(57) This invention relates to the treatment of substrates 21 with fluidized material in repetitive patterns 82 during application cycles. The treatment patterns made with this invention can be altered by changing machine operating parameters. The patterns of fluidized material are applied to substrates using intermittent charges of compressed air. The intermittent charges of compressed air pass through a venturi slot in an applicator 40 which creates a region of low pressure in the charges adjacent to a region where the fluidized material accumulates between application cycles. This region of low pressure helps to entrain the fluidized material in the charge of compressed air. After the fluidized material is entrained in the charge of compressed air, the charge deposits the fluidized material on the substrate.

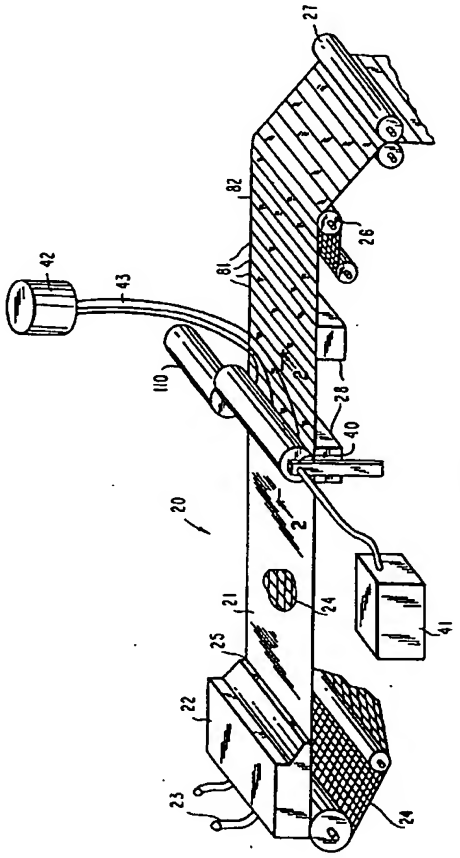


FIG. 1

EP 0 598 559 A1

Background of the Invention

This invention relates to a method and apparatus for treating paper with other material in repetitive patterns. More particularly, the invention relates to a method and apparatus whereby repetitive treatment patterns are created without contact between the paper and the apparatus.

Methods for altering or enhancing the characteristics of paper are well known in the papermaking art. For example, many techniques have been developed for imprinting or coating paper webs. These include gravure presses, blade coating, roller coating, silkscreening and stenciling methods. Bogardy U.S. Patent No. 4,968,534 describes a stenciling apparatus wherein a continuous stencil comes into facing engagement with a paper web during the application procedure. The apparatus includes a preparation step where air is evacuated from the web through the pattern stencil prior to the application step in order to facilitate the treatment procedure. The pattern applied by the device can be altered by changing the stencil used.

The apparatus of Bogardy U.S. Patent No. 4,968,534 is typical of many of the other previously known treatment devices because the apparatus contacts the paper web during the application process. These previously known devices, as a result, can only be used at points in the papermaking process where the paper is sufficiently stable to withstand the contact. This limits flexibility in placement of these devices, because the devices cannot be incorporated in a papermaking machine at relatively early stages of the papermaking process.

Stenciling and other previously known methods generally transfer a predetermined pattern to a treated article. The only way to change the pattern applied is to replace the pattern-forming element of the device. In other words, there is no easy way to alter the pattern by, for instance, merely changing operating parameters. This characteristic particularly limits the applicability of these devices in mass-production situations where it is desirable to apply several patterns to paper being produced.

Another characteristic of previously known devices like that of Bogardy U.S. Patent No. 4,968,534 is that the amount of material applied cannot be varied appreciably. In essence, since the devices are in contact with the web, there must be penetration of the web by the material during the application procedure for significant amounts of material to be applied to the web. The required penetration may not be possible depending on the combined characteristics of the paper and the treatment material, thereby resulting in less than optimum treatment of the paper.

A particular limitation of devices like that of Bogardy U.S. Patent No. 4,968,534 is that a stenciling device incorporating a pattern for applying relatively-closely spaced bands of narrow width to cigarette paper would experience flexure of the stencil and resultant pattern non-uniformity when scaled to the size of a papermaking machine of the type used to make cigarette paper.

One other characteristic of previously known devices is that in order to maintain sufficient pressure, a sump of treatment material needs to be positioned above the stencil. This solution generally requires that sump material be recirculated to a reservoir. This constant recirculation of unused treatment material may allow contamination of the treatment material.

Improved methods for altering the characteristics of paper which overcome these limitations are of particular interest to cigarette manufacturers. Cigarette manufacturers have long appreciated the usefulness of adding flavorings or burn control additives to paper. More recently, it has been recognized that cigarette paper could be altered so that smoking articles incorporating the altered paper will have a reduced burn rate when the smoking article is not drawn on by a smoker.

Paper cigarette wrappers have burn characteristics, including burn rates and static burn capabilities. It is known that burn characteristics can be modified by adding fillers, coatings, or other additives to papers. patent application Serial No.

includes a description of many of these methods, and also discloses a nonlaminated paper of variable basis weight and suggests that burn rate control of that paper can be achieved economically with mass-production techniques. The variable basis weight is achieved by applying bands of cellulosic slurry in a pattern to a moving paper web during production while leaving regions of the paper between the pattern untreated. The basis weight of the paper is increased in regions where the slurry has been applied, and when the paper is incorporated in a smoking article, the smoking article has a decreased burn rate in those regions. Limitations of prior mass-production application methods like that disclosed in Bogardy U.S. Patent No. 4,968,534 render them less effective for altering the basis weight of cigarette paper in patterns as described in above-incorporated United States patent application Serial No. 07/614,620.

It would be desirable to provide a method and a durable and inexpensive apparatus for treating paper webs which can be easily incorporated into present papermaking machines at various points in the papermaking process.

It would be desirable to provide a method and apparatus for treating paper webs without contact between the paper web and the apparatus.

It would be desirable to provide a method and apparatus for applying chemical treatments to paper webs in patterns wherein the pattern applied can be altered by changing machine operating parameters.

It would be desirable to provide a method and ap-

paratus for applying material to moving paper webs where the amount of material applied can be varied appreciably.

It would be desirable to provide a method and apparatus for applying material to a large quantity of moving paper web in uniform patterns in a continuous manner, and at high speeds.

It would be desirable to provide a method and apparatus for applying material to moving paper webs where the amount of material being applied can be accurately metered, eliminating the need for recirculation of treatment material.

It would further be desirable to provide a method and apparatus for applying chemical treatments to cigarette paper so that burn rate control can be achieved economically with mass production techniques.

The invention comprises an apparatus and method for applying fluidized material to paper in repetitive patterns to alter the characteristics of the paper. As used herein, "fluidized material" means a substantially solid material suspended in a liquid -- e.g., as a slurry -- or dissolved in solution. Although in the preferred embodiment described below the invention is used for producing paper with variable burn characteristics, the invention could be used to apply may different fluidized materials to achieve differing paper characteristics, the invention could be used to apply may different fluidized materials to achieve differing paper characteristics. For instance, the invention could be used to apply compounds which are detectable by electromagnetic means, for use in, e.g., security applications. The invention could also be used to apply dyes, inks or flavorings.

In a preferred embodiment, the apparatus of the invention, a venturi slot applicator is mounted on a papermaking machine directly over the Fourdrinier wire between the wet line and the couch roll. The venturi slot applicator comprises a rotary air valve and a feedblock. The feedblock contains an applicator slot with an inlet adjacent to the rotary air valve and an outlet adjacent to the pulp web. Slurry is pumped into the applicator slot through supply slots in communication with a slurry source. Slurry accumulates continuously on ledges in the applicator slot adjacent to the supply slots between application cycles. The ledges and surface tension of the slurry prevent the slurry from dripping out of the applicator slot prematurely between application cycles. Rotation of the rotary air valve assembly brings an outlet in the air valve adjacent to the inlet of the applicator slot at which point compressed air stored within the rotary air valve forces the slurry in the applicator slot out and onto the moving paper web. The applicator slot has a venturi region which assists in entraining the slurry in the charge of compressed air by creating a region of low pressure in the charge adjacent to the ledges where slurry accumulates between application cycles. The slurry is drawn into the charge by this region of low pressure. Continued rotation of the air valve seals the interior of the air valve, allowing additional slurry to again accumulate in the slot in preparation for the next application cycle.

In a second preferred embodiment channels in the rotary air valve are spaced in a pattern of varying angular spacings, which cause slurry to be applied to the pulp web in a pattern of varying spacings.

In a third preferred embodiment of the invention, the venturi slot applicator is incorporated in a machine to treat finished, dry paper. This alternate embodiment includes a drying means to facilitate the drying of slurry bands applied to the web.

The present invention relates to a method and apparatus for altering the characteristics of paper by treating the paper during or after the production process. With this invention many different paper characteristics can be achieved. For example, materials that confer distinctive characteristics upon the paper, such as compounds which are detectable by electromagnetic means, could be applied in accordance with the invention. Inks or dyes could also be applied in accordance with the invention. The invention could also be used to apply a pattern of flavor generating article such as that disclosed in commonly assigned U.S. Patent No. 5,060,671. In addition, the invention could be used to treat substrates other than paper. Although preferred embodiments of the invention relate to treatment of cigarette paper, it will be apparent that the invention has many applications.

Preferred embodiments of the invention are a method and apparatus for altering the basis weight of cigarette paper in select regions so that burn rate characteristics are altered in those regions. As used herein, "base web" refers to untreated regions of paper and "treated regions" are the regions of increased basis weight which are created in the base web by applying slurry in an application pattern.

An increase in basis weight of localized regions in a paper web may be achieved by increasing either the thickness, the density, or both in those regions. The increase in basis weight may be accomplished by depositing, onto an existing pulp web in a papermaking machine, additional fluidized material such as a second quantity of cellulosic pulp, or, alternatively, a filler material. As used herein, "fluidized material" means a substantially solid material suspended in a liquid -- e.g., as a slurry -- or dissolved in solution. Some examples of additional materials are highly refined cellulosic pulp, high surface area cellulosic fibers such as cellulon, microcrystalline cellulose such as Avicel or a mixture of highly refined pulp and calcium carbonate. Other insoluble, cellulose-compatible materials could also be used, such as amylopectin or certain modified celluloses.

The treated regions made in accordance with this invention have a basis weight above that of the base web. When paper made with the present invention is

incorporated in a smoking article, the smoking article will have variable burn rate characteristics. For example, the static burn rate of the smoking article may be substantially decreased during combustion of treated regions, because regions of increased basis weight have decreased porosity. The rate of oxygen diffusion through the paper in these regions is thereby decreased, retarding combustion of the smoking article.

The dimensions of the treated regions may also affect the burn characteristics of the paper and, consequently, a smoking article incorporating the paper. When the paper is incorporated in a cigarette, the treated regions form a series of rings of known width and separation along the longitudinal axis of the cigarette. Both the width of, and the degree of separation between these rings of treated paper have a substantial effect on the overall burn rate of the smoking article. The width and degree of separation of the rings effectively determine what percentage of the smoking article will experience a burn rate decreased from the nominal rate associated with the base web.

The present invention provides a method and apparatus for applying slurry in any desired application pattern to form treated regions. The invention also allows the application pattern to be changed by adjustment of machine operating parameters, to alter, e.g., the size and spacing of the treated regions comprising the application pattern. This allows the same machine to make papers with differing variable burn rate characteristics.

The invention will be further described with reference to the accompanying drawings, in which like reference characters to like parts throughout, and in which:

Fig. 1 is a perspective view of a paper making machine incorporating a first preferred embodiment of the present invention;

Fig. 2 is a vertical cross-sectional view of a venturi slot applicator in accordance with the invention, taken along line 2-2 of Fig. 1;

Fig. 3 is an enlarged view of area A of Fig. 2;

Fig. 4 is a vertical cross-sectional view of a second preferred embodiment of the invention; and

Fig. 5 is a perspective view of a third preferred embodiment of the invention.

A first preferred embodiment of the apparatus of this invention is shown in Fig. 1, which depicts the pulp web-forming area of a conventional Fourdrinier papermaking machine 20, adapted to produce a continuous pulp web 21. A headbox 22 contains a quantity of cellulosic pulp which is supplied to headbox 22 by a plurality of conduits 23 which communicate with a pulp source, such as a pulp storage tank (not shown).

Immediately below headbox 22 is an endless forming wire 24. A slice 25 defined in a lower portion of headbox 22 adjacent to wire 24 permits the pulp from the headbox 22 to flow through slice 25 onto the top surface of the wire 24 to form pulp web 21. Slice 25 is usually narrow in height in order to regulate the amount of pulp which flows from headbox 22. Slice 25 typically may extend substantially across the entire width of pulp web 21.

The top portion of wire 24 is adapted to move forwardly toward a couch roll 26 and away from slice 25. The direction from headbox 22 toward couch roll 26 is defined as the downstream direction. Once pulp web 21 has been formed, it passes under the apparatus of this invention – i.e., the venturi slot applicator 40 – which deposits additional fluidized material onto pulp web 21 with intermittent charges of compressed air.

Compressed air is supplied to venturi slot applicator 40 from an air compressor 41. The fluidized material is pumped under pressure from a storage tank 42 through a plurality of conduits 43 to the venturi slot applicator 40.

As shown in the cross-sectional views of Figs. 2 and 3, the venturi slot applicator 40 includes a rotary air valve 44, although other sources of intermittent charges of compressed air may be used. The rotary air valve 44 comprises several elements including rotor and stator elements. The rotor element comprises a rotary air valve drum 45. The rotary air valve drum 45 is cylindrical in shape and hollow. Machined into the surface of the rotary air valve drum 45 are a plurality of radial channels 46 which are in communication with the hollow interior 47 of the rotary air valve drum 45, and which extend perpendicular to the axis 48 of the rotary air valve drum 45. In Fig. 2, the channels 46 are equiangularly spaced about the periphery of rotary air valve drum 45. The channels 46 may also be arranged in a pattern of varying angular spacings. Hollow interior 47 of rotary air valve drum 45 is connected to the air compressor 41 of Fig. 1 which supplies the rotary air valve 44 with compressed air.

Rotary air valve drum 45 is mounted within stationary rotary air valve vessel 49, which serves as the stator element. Rotary air valve vessel 49 is also cylindrical in shape, and has a single radial channel 50 extending perpendicular to the axis 48 of the rotary air valve vessel 49, and the rotary air valve drum 45.

Rotary air valve drum 45 is adapted for rotation at a constant angular velocity by conventional drive means 110, which may be any number of motors and drive trains familiar to those skilled in the art. Rotation of rotary air valve drum 45 brings channels 46 in rotary air valve drum 45 sequentially into alignment with channel 50 in rotary air valve vessel 49. This allows a charge of compressed air to pass from hollow interior 47 of rotary air valve drum 45 through that one channel 51 of channels 46 in alignment with channel 50 and then through inlet 52 of channel 50.

The outlet 53 of channel 50 is adjacent to feedblock 54. Machined into feedblock 54 is an applicator slot 55, which is parallel to channel 50. Applicator slot

55 has a substantially rectangular cross-section in any plane parallel to the plane of pulp web 21. Inlet end 56 of the applicator slot 55 is in permanent alignment with channel 50. Outlet end 57 of slot 55 is adjacent to moving pulp web 21 which passes immediately below feedblock 54.

Feedblock 54 also has a plurality of slurry inlets 58. Through these slurry is supplied to the feedblock from the storage tank 42 of FIG. 1. Slurry from inlets 58 flows into cavity reservoirs 59 and applicator slot 55.. Cavity reservoirs 59 communicate with applicator slot 55 through supply slots 60. The size of supply slots 60 and the slurry supply pressure regulate the amount of slurry flowing into the applicator slot 55. The slurry flowing into applicator slot 55 flows onto ledges 61 in the applicator slot 55. These ledges are associated with the beginning of a venturi region 62 in the applicator slot. The slurry remains on ledges 61 between application cycles due to surface tension. As shown, the width of the applicator slot 55 is at a minimum in the venturi region 62 and then the width increases again.

Application cycles are initiated by alignment of channel 51 in rotary air valve drum 45 with channel 50 in rotary air valve vessel 49. This alignment allows a charge of compressed air to flow from hollow interior 47 of rotary air valve drum 45 and into channel 50. This charge travels down channel 50 and into applicator slot 55. When the charge of compressed air encounters the venturi region 62, its velocity increases. This velocity increase is accompanied by a decrease in pressure. This decrease in pressure occurs adjacent to the ledges 61 where the slurry has been accumulating between application cycles, and assists in entraining the slurry in the charge of compressed air. After passing through the venturi region 62 the charge of compressed air with entrained slurry exits the applicator slot 55 and impacts the pulp web 21, depositing the entrained slurry onto the pulp web 21.

Continued rotation of rotary air valve 45 moves channel 51 out of alignment with channel 50, thus temporarily removing the source of compressed air. This interruption allows slurry to accumulate in the applicator slot 55 in preparation for the next application cycle.

Referring again to FIG. 1, repeated application cycles cause a series of bands 81 to be applied to the pulp web 21. These bands are substantially rectangular, corresponding to the shape and exit dimensions of the applicator slot 55. These bands 81 preferably are substantially parallel to one another and equally spaced and form the application pattern 82 which alters the characteristics of the pulp web 21. As described above, the pressure of material supplied to the applicator slot 55 is variable, allowing control of the amount of material applied in the individual bands 81.

The intervals between bands 81 may also be varied by altering the angular velocity of the rotary air valve drum 45. Slowing the drum, for instance, would result in bands 81 being further apart, while accelerating the drum would result in bands 81 being closer together. Continually altering the angular velocity of drum 45 allows one to create a pattern of unequally spaced bands 81.

In the preferred embodiment, the bands 81 are applied perpendicular to the direction of travel of the pulp web 21. The bands can also be applied at an oblique angle by pivoting the venturi slot applicator 40 in a plane parallel to the plane of the pulp web 21 so that the applicator slot 50 is at an oblique angle to the direction of travel of the pulp web 21.

In a second preferred embodiment bands 81 may also be applied in a repetitive pattern of varying spacings by employing a rotary air valve drum 45 with channels 46 arranged in a repetitive pattern of varying angular spacings, as shown in FIG. 4, preferably operating at constant angular velocity.

Other patterns may be applied with the venturi slot applicator by constructing a feedblock 51 with a slot (not shown) having a different cross-section in a plane parallel to the pulp web 21. For instance, if the slot had a circular cross-section, a series of circular regions of fluidized material could be applied to pulp web 21.

After the venturi slot applicator 40 has applied the application pattern 82 to the pulp web 21, the web continues to move in a downstream direction. As wire 24 begins to move downwardly about couch roll 26 and back toward headbox 22, pulp web 21 is delivered from wire 24 to a plurality of press rolls 27 and then to a conventional dryer section of papermaking machine (not shown). As pulp web 21 advances in the downstream direction, excess water is permitted to pass through wire 24. Vacuum boxes 28 may be applied to portions of the underside of wire 24 to assist in the removal of water from pulp web 21. Locating a vacuum box 28 underneath wire 24 at the application point assists the application process by assisting penetration and reducing splashback. Couch roll 26 may be adapted to provide a vacuum through wire 24 to the underside of pulp web 21 to remove additional water.

In a third preferred embodiment of the invention, shown in FIG. 5, the venturi slot applicator 40 has been incorporated in a machine to treat premanufactured paper. The machine has a roll of premanufactured paper 90 mounted on a feedshaft 91. The paper on the roll 90 is fed between an upper idler 92 and a lower idler 93 and onto a continuous moving web 94. A continuous moving web may not be needed, depending on paper strength. For example, the paper may be supported by a shoe (not shown) familiar to those skilled in the art. The venturi slot applicator is mounted above the continuous moving web 94 which is supporting the paper 90 to be treated. After the application pattern 82 has been applied to the paper 90

by the venturi slot applicator 40, the paper moves underneath a dryer 95. A number of types of drying means familiar to those skilled in the art including felt absorption, heated drums and infrared drying may be used. After the application pattern 82 has been dried by the dryer 95, the paper moves between the final upper idler 96 and final lower idler 97. The paper 90 is then taken up by a take-up roll 98 mounted on a take-up shaft 99.

Thus it is seen that an apparatus and method for treating paper in repetitive patterns where the repetitive patterns are made without contact between the apparatus and paper and where the patterns applied can be altered by changing apparatus operating parameters is provided.

Claims

1. A method of applying a fluidized material to a substrate comprising:
   (a) moving a substrate along a path;
   (b) introducing a fluidized material into an orifice adjacent the substrate;
   (c) admitting a charge of compressed air into the orifice; and
   (d) discharging the fluidized material in the orifice onto the substrate adjacent the slot with the charge of compressed air.

2. A method according to claim 1 wherein the substrate comprises a web.

3. A method according to claim 2 wherein the web is a paper web.

4. A method according to claim 3 wherein the fluidized material comprises a slurry for altering burn rate characteristics of the paper web.

5. A method according to any preceding claim of applying a fluidized material to a web in a series of application cycles comprising:
   (a) moving a web along a path;
   (b) continuously pumping a fluidized material under pressure into a slot located in a feedblock adjacent the web, the fluidized material accumulating in the slot between application cycles in an accumulation region of the slot, the slot having a venturi region where the width of the slot decreases to a minimum width and increases again, the venturi region of the slot being adjacent the accumulation region, the slot having an inlet adjacent to a source of compressed air and an outlet adjacent to the web;
   (c) admitting a charge of compressed air from the source of compressed air into the inlet during each application cycle, the charge of compressed air travelling in the slot toward the web, the velocity of the charge of compressed air increasing in the venturi region, creating a region of low pressure adjacent the accumulation region, thereby entraining the fluidized material in the accumulation region in the compressed air; and
   (d) discharging the fluidized material entrained in the compressed air through the outlet in the slot onto the web located adjacent the slot during each of application cycle.

6. A method according to claim 5 wherein the fluidized material is discharged onto the web in an application pattern comprising regions treated by application of the material.

7. A method according to claim 6 wherein the treated regions are a plurality of substantially rectangular bands of material substantially parallel to one another.

8. A method according to any of claims 5 to 7 wherein the bands of fluidized material applied to the web lie perpendicular to the direction of travel of the web.

9. A method according to any of claims 5 to 7 wherein the bands of fluidized material applied to the web lie at an oblique angle to the direction of travel of the web.

10. A method according to any of claims 5 to 9 wherein the application cycles occur at equal time intervals and the web moves at a constant velocity whereby the fluidized material is applied at equally spaced intervals along the web.

11. A method according to any of claims 5 to 10 wherein the application cycles occur in a repetitive pattern of varying time intervals whereby the fluidized material is applied in a repetitive pattern of varying spacings along the web.

12. A method according to any of claims 5 to 11 further comprising applying a vacuum to the web after the fluidized material has been applied to the web.

13. A method according to any of claims 5 to 12 further comprising drying the web after the fluidized material has been applied to the web.

14. Apparatus (20) for applying a fluidized material to a substrate (21) (90) comprising:
   means (24) for moving a substrate along a path;

an applicator (40) having an orifice (55) for holding fluidized material adjacent the substrate the orifice having an inlet (56) for admitting a charge of compressed air into the orifice and an outlet (57) through which fluidized material is discharged by the compressed air onto the substrate.

15. Apparatus (20) according to claim 14 further comprising a means for supplying the inlet (56) of the orifice (55) with a charge of compressed air.

16. Apparatus (20) according to claim 16 wherein the substrate comprises a web (21) (90).

17. Apparatus (20) according to claim 16 wherein the web is a paper web (21) (90).

18. Apparatus (20) according to claim 17 wherein the fluidized material comprises a slurry for altering burn rate characteristics of the paper web (21) (90).

19. Apparatus (20) according to any of claims 14 to 18 for applying a fluidized material to a web (21) (90) in a series of application cycles, comprising:

means (24) for moving a web (21) (90) along a path;

an applicator (40) for holding fluidized material adjacent the web, the applicator having a slot (55) having an inlet (56) for admitting a charge of compressed air during each application cycle and an outlet (57) adjacent the web, the charge of compressed air travelling toward the outlet;

an accumulator associated with the slot (55) for accumulating fluidized material in accumulation region of the slot between application cycles;

venturi means (62) associated with the slot (55) between the inlet (56) and the outlet (57) creating a region of low pressure in the charge of compressed air adjacent the accumulation region, thereby entraining fluidized material in the accumulation region in the charge of compressed air, the charge of compressed air leaving the slot through the outlet and depositing the fluidized material entrained in the charge on the web (21) (90) during each application cycle.

a continuous supply (41) to the applicator (40) of fluidized material under pressure; and

a means (44) for supplying the applicator (40) with the charge of compressed air during each application cycle.

20. Apparatus (20) according to claim 19 wherein the slot (55) is rectangular in cross section in a plane parallel to the plane of the web (21) (90), whereby fluidized material applied to the web during the application cycles forms a series of substantially rectangular substantially parallel bands (81) of fluidized material on the web.

21. Apparatus according to claim 20 wherein the slot (55) is perpendicular to the direction of travel of the web (21) (90), whereby the bands (81) of fluidized material applied to the web are perpendicular to the direction of travel of the web.

22. Apparatus (20) according to claim 20 wherein the slot (55) is at an oblique angle to the direction of travel of the web (21) (90), whereby the bands (81) of fluidized material applied to the web are at an oblique angle to the direction of travel of the web.

23. Apparatus (20) according to claim 20, wherein the application cycles occur at equal time intervals whereby the fluidized material is applied at equally spaced intervals along the web (21) (90).

24. Apparatus (20) according to claims 19 to 23 wherein the application cycles occur in a repetitive pattern of varying time intervals whereby fluidized material is applied in a repetitive pattern of varying spacings along the web (21) (90).

25. Apparatus (20) according to claim 19 to 24 wherein the pressure of fluidized material supplied to the slot (55) is variable, whereby the amount of fluidized material accumulating in the slot (55) between application cycles and being discharged during the application cycles is variable.

26. A venturi slot applicator (40) for applying a fluidized material to a moving web (21) (90) during application cycles while the moving web passes underneath the venturi slot applicator comprising:

a feedblock (54) positioned above the moving web (21) (90) having an applicator slot (55) and at least one supply slot (66) and at least one cavity reservoir (59) for holding fluidized material, the cavity reservoir communicating with the applicator slot through the supply slot, the feedblock having at least one orifice (58) for admitting fluidized material into the cavity reservoir; wherein:

the applicator slot (55) has an inlet (56) for admitting a charge of compressed air during each application cycle and at least one ledge (61) adjacent the supply slot (60) for accumulating the fluidized material between each application cycle, the applicator slot having a venturi region (62) adjacent the ledge, the width of the applica-

tor slot decreasing to a minimum in the venturi region and then increasing again, the applicator slot having an outlet (57) above the web (21) (90); the venturi slot applicator further comprising:

a continuous supply (41) of fluidized material to the orifice (58) of the feedblock (54) under pressure, the pressure forcing the fluidized material through the cavity reservoir (59) and supply slot (60) and into the applicator slot (55);

a rotary air valve (44) comprising a rotor (45) inside a stator (49); the rotor and stator being cylindrical in cross section and hollow, the rotor being mounted coaxially within the stator, the rotor and stator having a common axis (48); wherein:

the rotor (45) has at least one channel 946) extending from its outer surface through to the hollow interior (47) of the rotor;

the stator (49) having a channel (52) surface of said stator, extending from its outer surface through to the hollow interior of the stator, the channel having an inlet adjacent the rotor and an outlet (53) adjacent the inlet (57) of the applicator (55); and

a compressed air supply (42) for supplying compressed air to the hollow interior (47) of the rotor (45);

a drive (110) for rotating the rotor, the drive bringing the channel (46) in the rotor (45) into periodic alignment with the channel (52) in the stator (49) during each application cycle, allowing a charge of compressed air to travel from the hollow interior (47) of the rotor through the channels (46) (52) in the rotor and stator into the applicator slot (55), the venturi region (62) creating a region of low pressure in the charge of compressed air discharging the material entrained in the charge through the outlet (57) of the applicator slot (55) and onto the moving web (21) (90).

27. A venturi applicator (40) according to claim 26 wherein the moving web is a moving paper web (21) (90).

28. A venturi slot applicator (40) according to claim 26 wherein the fluidized material comprises a slurry to alter burn rate characteristics of the moving paper web (21) (90).

29. A venturi slot applicator (40) according to claim 26, 27 or 28 wherein the slot (55) is rectangular in shape in a plane parallel to the plane of the moving web (21) (90) whereby the fluidized material applied to the moving web during the application cycle forms a series of parallel rectangular bands (81) of fluidized material on the moving web.

30. A venturi slot applicator (40) according to claim 29 wherein the slot (55) is perpendicular to the direction of travel of the moving web (21) (90), whereby the bands (81) of fluidized material applied to the moving web are perpendicular to the direction of travel of the moving web.

31. A venturi slot applicator (40) according to claim 29 wherein the slot (55) is at an oblique angle to the direction of travel of the moving web (21) (90), whereby the bands (81) fluidized material applied to the moving web are at an oblique angle to the direction of travel of the moving web.

32. A venturi slot applicator (40) according to any of claims 26 to 31 wherein the channels (46) in the rotor (45) are regularly angularly spaced and the angular velocity of the rotor is constant whereby fluidized material is applied at equally spaced intervals along the moving web (21) (90).

33. A venturi slot applicator (40) according to claim 32 wherein the angular velocity of the rotor (45) is variable over a range of angular velocities whereby the equally spaced intervals are variable over a range of linear spacings.

34. A venturi slot applicator (40) according to any of claims 26 to 31 wherein the channel (46) in the rotor (45) occur in a repetitive pattern of angular spacings and the angular velocity of the rotor is constant whereby fluidized material is applied in a repetitive pattern of varying linear spacings along the moving web (21) (90).

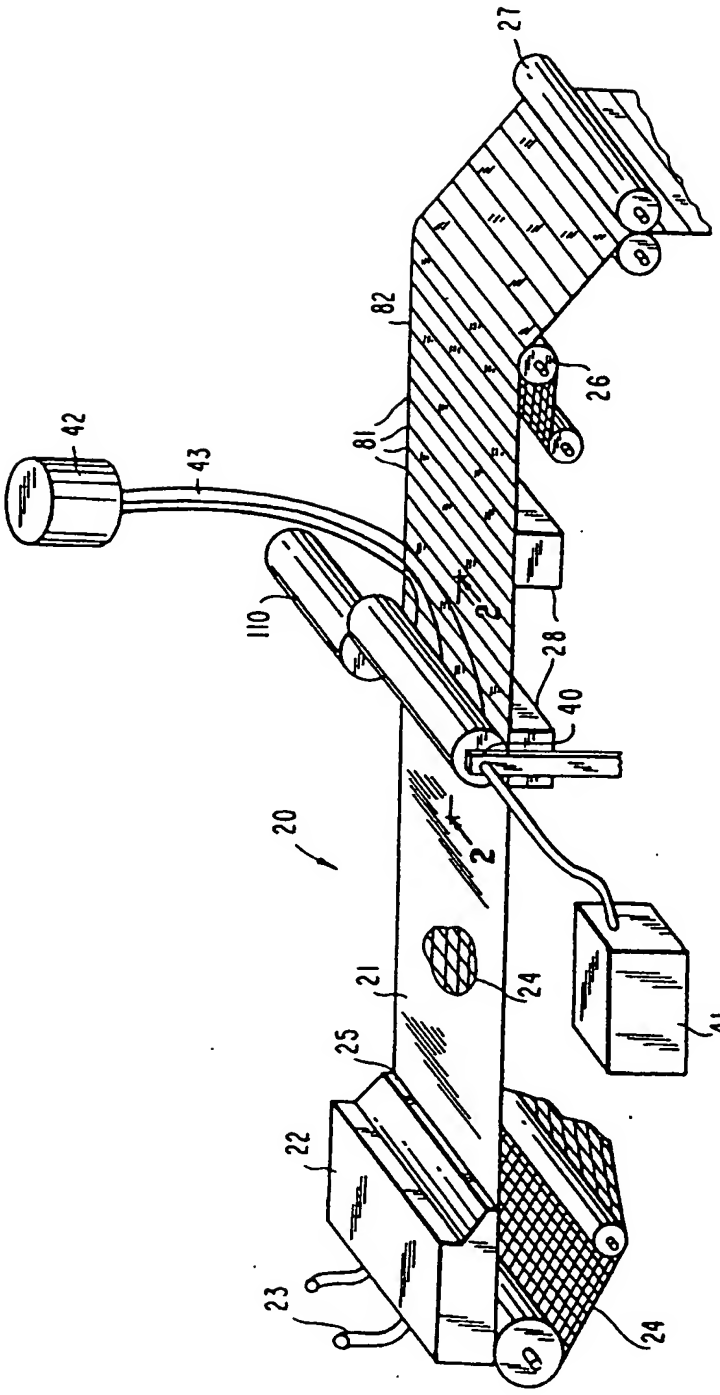


FIG. 1

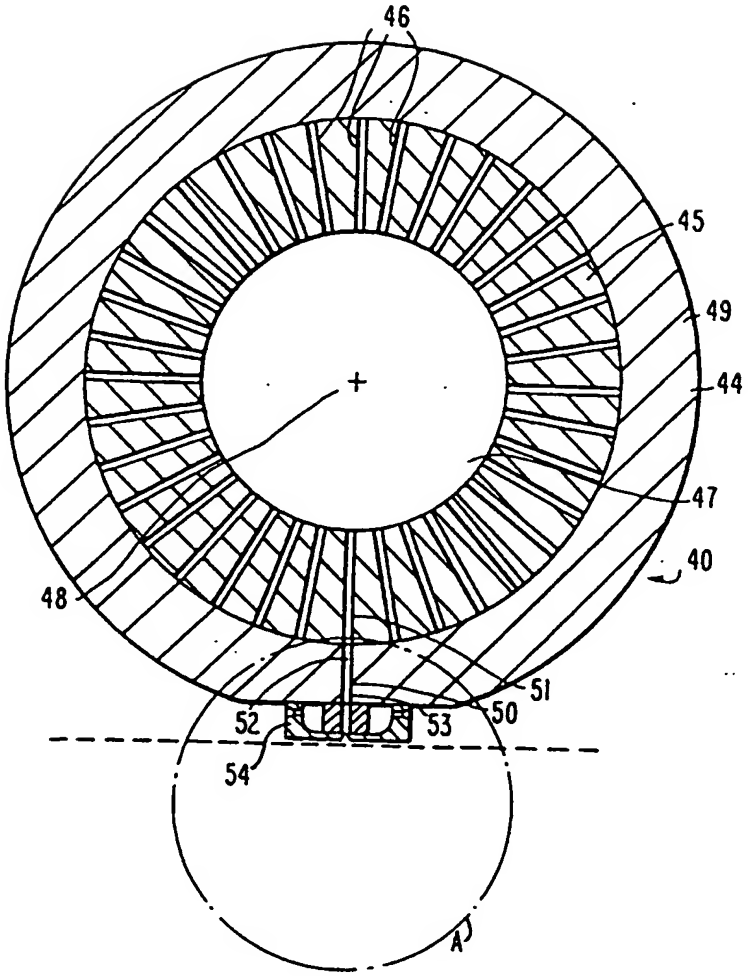


FIG. 2

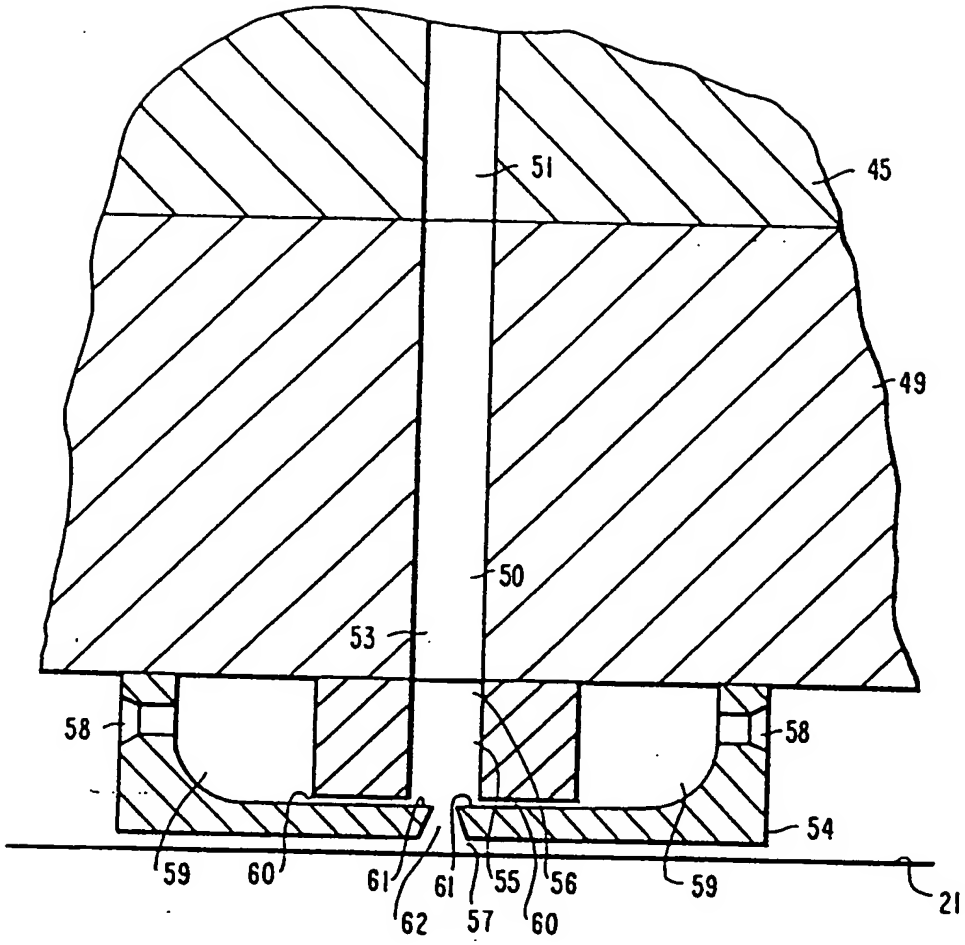


FIG. 3

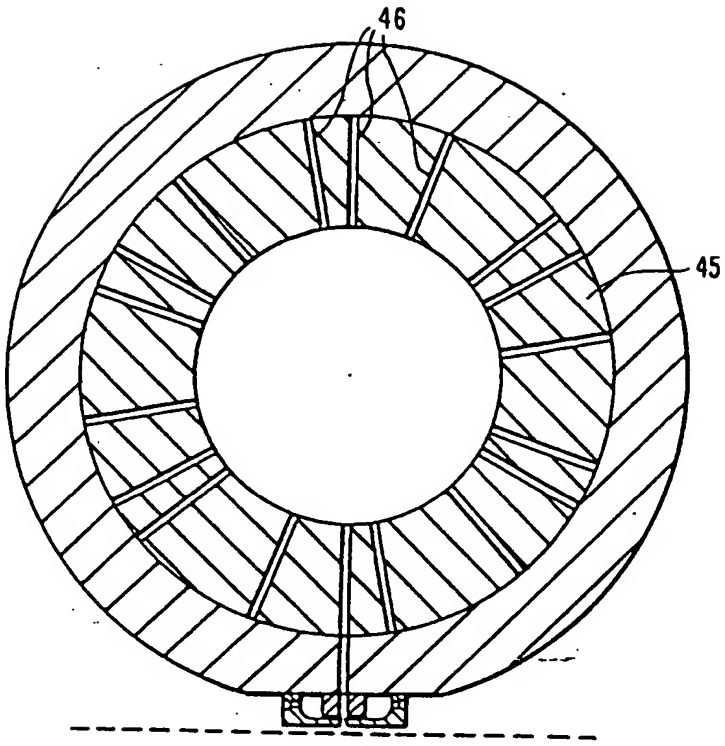
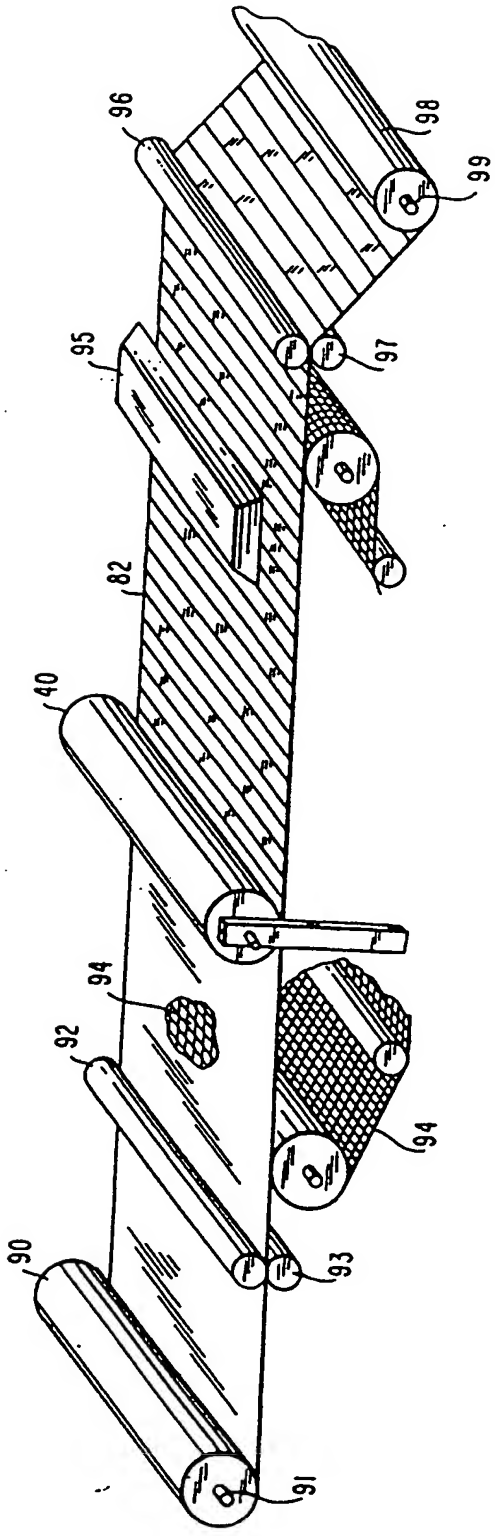


FIG. 4

FIG. 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 9019

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
P,X	EP-A-0 559 453 (PHILIP MORRIS PRODUCTS INC.) * the whole document *	1-19	D21H23/50 B05C5/02
A	DATABASE WPI Section Ch, Week 8620, Derwent Publications Ltd., London, GB; Class F09, AN 86-130470 & SU-A-1 186 721 (PAPER RES INST) 23 October 1985 * abstract; figure *	26-34	
A	FR-A-2 075 005 (ACUMETER LABORATORIES INC.) * the whole document *		
A	EP-A-0 081 100 (MASCINENFABRIK ALFRED SCHMERMUND GMBH & CO.) * the whole document *		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

D21H
B05C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 February 1994	Songy, O

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)